ABSTRACT

[Abstract of the Disclosure]

A compact digital zoom camera includes a module base having an image sensor therein, a gear train installed at a side of an upper surface of the module base, a lens guide base installed on the module base and having a guide cylinder portion integrally formed thereon in which at least two groups of linear guides are formed in a lengthwise direction thereof, a driving motor installed at a motor installation portion on the lens guide base to rotate the gear train, a cam barrel rotatably installed at an outer side of the lens guide base and having a cam barrel gear portion engaged with any gear of the gear train and at least two groups of cam slots formed there in, at least two lens frames having at least two groups of linear guide portions respectively inserted in the two groups of linear guides of the lens guide base and guided thereby and at least two groups of cam pins respectively inserted in insertion holes formed in the linear guide portions and fixed therein such that end portions of the two groups of cam pins are respectively inserted in at least two groups of cam slots formed in the cam barrel and restricted thereby, and at least two groups of lenses respectively fixed on the two groups of lens frames.

[Representative Drawing]

FIG. 18

SPECIFICATION

[Title of the Invention]

DIGITAL ZOOM CAMERA AND CELLULAR PHONE WITH SAME

[Brief Description of the Drawings]

FIG. 1 is a perspective view illustrating a cellular phone having a compact digital zoom camera according to a preferred embodiment of the present invention;

FIG. 2 is a perspective view illustrating a digital zoom camera separated from the cellular phone of FIG. 1;

FIG. 3 is a plan view of the digital zoom camera of FIG. 2;

FIGS. 4 and 5 are sectional views, taken along line A-A of FIG. 3, in different zoom states;

FIGS. 6 through 19 are perspective views, plan views, and sectional views illustrating the digital zoom camera of FIG. 2 by the respective assembly steps;

FIG. 20 is an exploded perspective view of a lens frame having lenses inserted therein;

FIG. 21 is a front view of the lens frame of FIG. 20 in a disassembled state;

FIG. 22 is a sectional view taken along line D-D of FIG. 21;

FIGS. 23 and 24 are views illustrating a cam barrel in a development state;

FIGS. 25 through 27 are sectional views showing the relative positions of first through third lenses in a zoom state;

FIG. 28 is a flow chart showing a method of controlling a driving motor of a digital zoom camera;

FIG. 29 is a waveform diagram of a power applied to a driving motor of the digital zoom camera; and

FIG. 30 is a block diagram showing a state in which the compact digital zoom camera according to the present invention is installed in a cellular phone.

< Explanation of Reference numerals designating the Major Elements of the Drawings >

21.22.23. lens	25. module cover
61. module base	91. gear train

122. guide cylinder portion 141. driving motor
143. PCB 161. cam barrel

[Detailed Description of the Invention]

[Object of the Invention]

[Technical Field of the Invention and Related Art prior to the Invention]

The present invention relates to a compact digital zoom camera, and more particularly, to a compact digital zoom camera which can be installed in a compact portable device such as a cellular phone, and a cellular phone having the same.

In general, digital cameras capable of photographing are installed in compact portable devices such as cellular phones or PDAs (personal digital assistants). Since the digital camera installed in a portable device has a very small size suitable for the portable devices, the structure of the digital camera needs to be simplified. Thus, a short-focus camera having a relatively simple structure is adopted therefor.

An image photographed by using a short-focus camera can be magnified by using a digital zoom. However, if the image is magnified by using a digital zoom, resolution of the image is lowered so that an image quality is deteriorated.

To solve the above problem, installing a compact digital zoom camera at a portable device has been suggested. For example, Korean Patent Application No. 2002-29031 filed by the present applicant on May 24, 2002 discloses a compact digital zoom camera provided to a portable device. However, since the structure of the portable device is relatively complicated and an end portion of a zoom lens protrudes outside from the device, when an impact is applied to a barrel of the camera, the zoom lens may slip out of the device or a cam pin may be broken.

[Technical Goal of the Invention]

To solve the above and/or other problems, the present invention provides an improved compact digital zoom camera for a portable device.

[Structure and Operation of the Invention]

According to an aspect of the present invention, a compact digital zoom camera comprises a module base having an image sensor therein, a gear train installed at a side of an upper surface of the module base, a lens guide base installed on the module

base and having a guide cylinder portion integrally formed thereon in which at least two groups of linear guides are formed in a lengthwise direction thereof, a driving motor installed at a motor installation portion on the lens guide base to rotate the gear train, a cam barrel rotatably installed at an outer side of the lens guide base and having a cam barrel gear portion engaged with any gear of the gear train and at least two groups of cam slots formed there in, at least two lens frames having at least two groups of linear guide portions respectively inserted in the two groups of linear guides of the lens guide base and guided thereby and at least two groups of cam pins respectively inserted in insertion holes formed in the linear guide portions and fixed therein such that end portions of the two groups of cam pins are respectively inserted in at least two groups of cam slots formed in the cam barrel and restricted thereby, and at least two groups of lenses respectively fixed on the two groups of lens frames.

A Wide limit protruding portion and a Tele limit protruding portion are formed on the motor installation portion and at a side of the lens guide base, respectively, to limit the rotation of the cam barrel by contacting the side surface of the cam barrel gear portion.

The driving motor is a DC driving motor.

A waveform of a voltage signal of a power applied to the driving motor is pulse waveform having a portion for applying the power and a portion for not applying the power, and the power is applied for a time limit from a Tele zoom state to a Wide zoom state.

The two groups of linear guides formed on the guide cylinder portion of the lens guide base are formed at an interval of 120° on the guide cylinder portion.

The two groups of cam slots formed in the cam barrel includes first through third cam slots, the first cam slot and the second cam slot are inclined in the opposite direction to each other, and the third cam slot has a reversed V shape.

An allowance is formed between an end portion of each of the two groups of cam slots and each of the two groups of cam pins when the cam barrel is in the Tele or Wide zoom state.

The two groups of lenses are respectively installed inside lens holders and at least one lens holder is fixed to at least one lens frame.

At least two groups of lens shields to limit an optical axis and protect the lenses are respectively arranged on surfaces of the two groups of lenses.

The gear train comprises a motor gear connected to a rotation shaft of the driving motor, first through fifth reduction gears to reduce the rotation of the motor gear, and a transmission gear engaged with the cam barrel gear portion.

The gear train is inserted in a concave formed in an upper surface of the module base.

An infrared ray shielding filter is arranged in front of the image sensor in the module base.

According to another aspect of the present invention, a cellular phone or a portable digital device has a compact digital zoom camera comprising a module base having an image sensor therein, a gear train installed at a side of an upper surface of the module base, a lens guide base installed on the module base and having a guide cylinder portion integrally formed thereon in which at least two groups of linear guides are formed in a lengthwise direction thereof, a driving motor installed at a motor installation portion on the lens guide base to rotate the gear train, a cam barrel rotatably installed at an outer side of the lens guide base and having a cam barrel gear portion engaged with any gear of the gear train and at least two groups of cam slots formed therein, at least two lens frames having at least two groups of linear guide portions respectively inserted in the two groups of linear guides of the lens guide base and guided thereby and at least two groups of cam pins respectively inserted in insertion holes formed in the linear guide portions and fixed therein such that end portions of the two groups of cam pins are respectively inserted in at least two groups of cam slots formed in the cam barrel and restricted thereby, and at least two groups of lenses respectively fixed on the two groups of lens frames.

Preferred embodiments of the present invention will now be described with reference to the attached drawings.

FIG. 1 is a perspective view illustrating a cellular phone having a compact digital zoom camera according to a preferred embodiment of the present invention.

Referring to FIG. 1, a typical cellular phone consists of a main body 1 and a folder 2 rotatably installed by a hinge 3 with respect to the main body 1. A plurality of numeric input buttons 4 are installed on the main body 1. A microphone 7 is installed at a side of the main body 1 while a speaker 6 is installed at a side of the folder 2. A digital zoom camera 8 according to a present preferred embodiment of the present invention is installed at a side of the hinge 3 of the folder 2. A "Tele" button 9 and a

"wide" button 10, which control a zoom state of the digital zoom camera 8, are installed on the main body 1. A release button 11 pressed to photograph is installed on the main body 1.

FIG. 2 shows the digital zoom camera 8 by separating the same from the cellular phone shown in FIG. 1.

Referring to FIG. 2, the digital zoom camera 8 can be separated as a module. A plurality of lenses, a driving motor, and a driving semiconductor are provided in a space between a module cover 25 and a module cover base portion 26, thereby forming a module. A connection flexible PCB 27 is extended from the module to electrically connect the modularized digital zoom camera 8 to a portable device such as a cellular phone. A connector 28 is installed at a side of the connection flexible PCB 27 and connected to another connector (not shown) provided in the portable device.

FIG. 3 is a plan view of the digital zoom camera of FIG. 2. FIGS. 4 and 5 are sectional views of taken long line A-A of FIG. 3.

Referring to FIGS. 4 and 5, at least two lens groups can be installed inside the module cover 25 of the digital zoom camera 8. In the present preferred embodiment, a first lens 21, a second lens 22, and a third lens 23 are installed so that intervals therebetween can be adjusted with respect to one another. An incident light passed through the first through third lenses 21, 22, and 23 is filtered by passing through an infrared ray shielding filter 31. The filtered light can be converted to electric signals by being incident on a well-known image sensor 32. The image sensor 32 is installed on a sensor PCB 33 and may a CCD sensor or a CMOS sensor. In FIG. 4, the first lens 21 is separated away from the second lens 22 toward in the front side of the module cover 25, thus being in a Wide state. In FIG. 5, the first lens 21 approaches the second lens 22 to be separated away from the front side of the module cover 25, thus being in a Tele state.

In FIG. 4, a cam barrel protrusion preventing step 25a is formed on an inner surface of the module cover 25. The cam barrel protrusion preventing step 25a prevents a cam barrel 161 from protruding outside when the cam barrel 161 rotates. The cam barrel protrusion preventing step 25a has a shape corresponding to a circular edge of an upper portion of the cam barrel 161 on the inner surface of an upper portion the module cover 25.

FIGS. 6 through 19 are perspective views, plan views, and sectional views illustrating the above-described digital zoom camera by the respective assembly steps. The overall structure of the digital zoom camera according to the present invention is described below with reference to FIGS. 6 through 19.

Referring to FIG. 6, a gear train installation portion 62 is formed at one side of a module base 61. The gear train installation portion 62 is a concave having a predetermined shape formed in a surface of the module base 61 so that a plurality of gears can be installed therein. By forming the gear train installation portion 62 in the module base 61, the overall thickness of the camera module can be decreased. A connection flexible PCB 27 is connected to a side of the sensor PCB 33 of FIG. 8 installed on a lower surface of the module base 61. A connector flexible PCB 63 is connected to the other side of the sensor PCB 33. The connector flexible PCB 63 is connected to a printed circuit board (PCB) 143 of FIG. 14 of a motor driving IC 142 of FIG. 14 installed on the module base 61. That is, driving of the motor driving IC 142 can be controlled by the connection flexible PCB 27, the sensor PCB 32 on a lower surface of the module base 61, and the connector flexible PCB 63.

FIG. 7 is a plan view of the module base 61 shown in FIG. 6. FIG. 8 is a sectional view taken along line B-B of FIG. 7.

Referring to FIG. 8, the infrared ray shielding filter 31 is installed in the module base 61 and the sensor PCB 33 is installed on a lower surface of the module base 61. Since the infrared ray shielding filter 31 is provided in the module base 61, a thickness of an overall camera module is decreased. Since the image sensor 32 is installed in the sensor PCB 33, the light passed through the infrared ray shielding filter 31 can be incident on the image sensor 32. The lower surface of the module base 61 is covered with a molding 88.

FIG. 9 illustrates that a plurality of gears are installed in the gear train installation portion 62 of FIG. 6 formed at one side of the module base 61. As shown in FIG. 10, the gear train includes a first reduction gear 101, a second reduction gear 102, a third reduction gear 103, a fourth reduction gear 104, a fifth reduction gear 105, and a transmission gear 106. Reference numeral 100 indicates a motor gear inserted around an end portion of a drive rotation shaft of a driving motor 141 of FIG. 14. A rotational driving force transferred by the motor gear 100 is transferred via the first through fifth reduction gears 101 through 105 and finally rotates the transmission gear 106. The

transmission gear 106 is engaged with a cam barrel gear portion 175 of FIG. 17 of the cam barrel 161 of FIG. 16 to rotate the cam barrel 161. As can be seen from FIG. 11, part of the fifth gear 105 is formed on an upper flat surface of the module base 61 and engaged with the transmission gear 106. Also, since the transmission gear 106 is formed at a position on the upper flat surface of the module base 61, it can be engaged with the cam barrel gear portion 175.

FIG. 12 illustrates that a lens guide base 121 is assembled on the module base 61 shown in FIG. 9. A guide cylinder portion 122 is integrally formed with the lens guide base 121. Also, a driving motor installation portion 129 is fixed at a side of the lens guide base 121.

At least two groups of linear guides can be formed on the guide cylinder portion 122 of the lens guide base 121. In an example shown in the drawing, a first linear guide 131, a second linear guide 132, and a third linear guide 133 are formed. The first through third linear guides 131, 132, and 133 are formed in a lengthwise direction on an outer circumferential surface of the guide cylinder portion 122 to guide the first through third lenses 21, 22, and 23. As it can be seen from the drawing, the first linear guide 131 extends from a middle portion of the guide cylinder portion 122 to an upper portion thereof, the second linear guide 132 extends from the middle portion to the upper portion, and the third linear guide 133 extends from the middle portion to a lower portion thereof. First through third lens frames 201, 202, and 203 of FIG. 22 are respectively fixed outside the first through third lenses 21, 22, and 23. First through third guide portions 211, 212, and 213 are formed outside the are inserted in the first through third lens frames 201, 202, and 203. The first through third guide portions 211, 212, and 213 are inserted in the first through third linear guides 131, 132, and 133, respectively. Thus, the first through third lenses 21, 22, and 23 can advance or retract along the guide cylinder portion 122, so that the intervals among the lenses can be adjusted. Three of the first through third linear guides 131, 132, and 133 form a group so that a total of nine guides are formed.

The lens guide base 121 is fixed to the module base 61 of FIG. 9 by a bolt 127. The driving motor 141 of FIG. 14 is installed on the motor installation portion 129 which is installed on the lens guide base 121. A rotation shaft of the driving motor 141 extends through a hole formed in the motor installation portion 129 to be coupled with the motor gear 100 shown in FIG. 10.

A wide limit protruding portion 135 is formed at a side of the motor installation portion 129 and functions as a stop portion to the cam barrel gear portion 175 formed on an outer circumference of the cam barrel 161 shown in FIG. 16. That is, as a side surface 175a of the cam barrel gear portion 175 contacts the Wide limit protruding portion 125, the cam barrel 161 is prevented from rotating in one direction (counterclockwise on the drawing). As shown in FIGS. 13 and 17, a Tele limit protruding portion 126 is formed at a side of the lens guide base 121. As the Tele limit protruding portion 126 contacts the other side surface 175b of the cam barrel gear portion 175 of FIG. 17, it prevents the cam barrel 161 from rotating in the other direction (clockwise on the drawing).

Referring to FIGS. 14 and 15, the driving motor 141 is installed on the motor installation portion 129 and the PCB 143 and the motor driving IC 142 are installed on the lens guide base 121. The motor driving IC 142 is mounted on the PCB 143 and connected to the connector flexible PCB 63 shown in FIG. 6. Typically, the motor driving IC is not installed on the PCB of the camera module, but on a PCB of a portable device such as a cellular phone. In such a case, the modularization of the camera is not possible and an efficient use of current is not available. In the present invention, as the motor driving IC 142 of the camera is installed in the camera module, the remaining space in the portable device can be utilized and simultaneously current can be efficiently used. A stepping motor or a DC motor can be usually used as the driving motor 141. Preferably, a DC motor which has a greater driving force and is cheaper is used. When a stepping motor is used, since the number of rotations according to a pulse can be estimated, a zoom state between a Wide mode and a "TELE' mode can be seen. However, it is disadvantage that the driving force of the stepping motor is not strong. The DC motor can recognize the position of the zoom lens by using a photosensor.

FIGS. 16 and 17 show that the cam barrel 161 is installed outside the lens guide base cylinder portion 122. The cam barrel 161 is cylindrical and rotatably installed on the lens guide base 121. The cam barrel gear portion 175 is formed in a predetermined section of an outer circumferential surface of the cam barrel 161. That is, as can be seen from FIG. 17, the cam barrel gear portion 175 is formed on the outer circumferential surface of the cam barrel 161 and is engaged with the transmission gear

106 described with reference to FIG. 10. Thus, when the transmission gear 106 is rotated by the driving motor 141, the cam barrel 161 is rotated accordingly.

At least two groups of cam slots can be formed in the cam barrel 161. In the example shown in the drawing, first through third cam slots 181, 182, and 183 are formed. At least two groups of cam pins provided on at least two lens frames shown in FIG. 20 are inserted in the first through third cam slots 181, 182, and 183. In the example shown in the drawing, first through third cam pins 216, 217, and 218 provided on the first through third lens frames 201, 202, and 203 are inserted in the first through third cam slots 181, 182, and 183, respectively. Since the first through third cam slots 181, 182, and 183 are formed inclined with respect to a horizontal surface, when the cam barrel 161 rotates, the first through third cam slots 181, 182, and 183 restrict the first through third cam pins 216, 217, and 218 provided on the first through third lens frames 201, 202, and 203. Accordingly, the first through third lens frames 201, 202, and 203 can linearly move along the first through third linear guides 131, 132, and 133 of the guide cylinder portion 122. That is, the first through third lens frames 201, 202, and 203 can move linearly by a combination of the linear guide operation of the first through third linear guides 131, 132, and 133 formed in the guide cylinder portion 122 and the restriction operation of the first through third cam slots 181, 182, and 183 formed in the cam barrel 161.

FIGS. 18 and 19 show a stat in which the first through third lenses are coupled to the guide cylinder portion 122.

Referring to FIGS. 18 and 19, the first lens 21 is coupled in the guide cylinder portion 122. The second and third lenses 22 and 23 which are not shown in the drawings are coupled in the guide cylinder portion 12. The first through third lenses are installed on the first through third lens frames 201, 202, and 203. The first through third cam pins 216, 217, and 218 can be inserted in the first through third cam slots 181, 182, and 183 formed in the cam barrel 161.

FIGS. 20 through 22 show that the first through third lenses are coupled to the first through third lens frames.

Referring to FIG. 20, each lens is installed inside a lens holder and a linear guide portion is formed on the lens holder. That is, at least two groups of linear guide portions are formed in each of at least two groups of lens holders. In a preferred embodiment shown in the drawing, the first lens 21 is installed in a lens holder 221 and

the lens holder 221 is installed inside the first lens frame 201. The first linear guide portion 211 is formed at an interval of 120° on the outer circumference of the first lens frame 201. The first linear guide portion 211 slightly protrudes outwardly from the first lens frame 201 and has a linear side surface parallel to each other in a radial direction of the first lens frame 201. The first linear guide portion 211 is inserted in the first linear guide 131 of the guide cylinder portion 122 shown in FIG. 12 and guided thereby. That is, the first linear guide portion 211 of the first lens frame 201 is guided linearly along the first linear guide 131 of the guide cylinder portion 122.

An insertion hole is formed in the first linear guide portion 211 and the first cam pin 216 is inserted in the insertion hole and fixed therein. The first cam pin 216 is inserted in the first cam slot 181 formed in the cam barrel 161 and restricted thereby, as shown in FIG. 16.

The second linear guide portion 212 and the third linear guide portion 213 are formed at an interval of 120° on the outer circumferential surfaces of the second lens frame 202 and the third lens frame 203, respectively. The second and third linear guide portions 212 and 213 protrude outwardly from the circumferential surfaces of the respective lens frames and have linear side surfaces parallel to each other in a radial direction of each lens frame. The second linear guide portion 212 and the third linear guide portion 213 are inserted in the second and third linear guides 132 and 133, as shown in FIG. 12.

The second linear guide portion 212 has an insertion hole 219 formed therein and the second cam pin 217 is inserted in the insertion hole and fixed therein. An end portion of the second cam pin 217 is inserted in the second cam slot 182, which is described with reference to FIG. 16, and restricted thereby.

Likewise, the third linear guide portion 213 has an insertion hole formed therein and the third cam pin 218 is inserted in the insertion hole and fixed therein. An end portion of the third cam pin 218 is inserted in the third cam slot 183, which is described with reference to FIG. 16, and restricted thereby.

In FIG. 21 the second lens frame 202 and the third lens frame 203 are disposed close to each other, but they can be actually separated.

FIG. 22 is a sectional view taken along line D-D of FIG. 21. As shown in FIG. 22, the first lens 21 is fixed on an inner circumferential surface of the lens holder 221 which is screwed to the first lens frame 201 at the outside. As a first lens shield 226 is

arranged on a front surface of the first lens 21, an optical path is limited and the first lens 21 is protected.

The second lens 22 is installed on an inner circumferential surface of the second lens frame 202. As a second lens shield 227 is arranged on a front surface of the second lens 22, an optical path is limited and the second lens 22 is protected.

The third lens 23 is fixed on an inner circumferential surface of the lens holder 223 which is screwed to the third lens frame 203 at the outside. As a third lens shield 228 is arranged on a front surface of the third lens 23, an optical path is limited and the third lens 23 is protected.

FIGS. 23 and 24 are views illustrating the cam barrel of FIG. 16 in a development state, in which FIG. 23 shows the cam barrel in a Wide zoom state while FIG. 24 shows the cam barrel in a Tele zoom state.

Referring to FIGS. 23 and 24, the first through third cam slots 181, 182, and 183 are formed in the cam barrel 161. The first cam slot 181 and the second cam slot 182 are inclined in the opposite directions to each other. That is, the first cam slot 181 is inclined such that a left end thereof is located higher than a right end while the second cam slot 182 is inclined such that a right end thereof is located higher than a left end. Also the third cam slot 183 has largely a reversed V shape.

The first through third cam pins 216, 217, and 218 are inserted in the first through third cam slots 181, 182, and 183, respectively. In the Wide zoom state, the respective cam pins 216, 217, and 218 approach the left end portions of the respective cam slots 181, 182, and 183, respectively. Here, the side surface 175a of the cam barrel gear portion 175 formed at a lower portion of the outer circumferential surface of the cam barrel 161 contacts the Wide limit protruding portion 125, so that the cam barrel 161 is prevented from rotating further.

On the contrary, in the Tele zoom state, the respective cam pins 216, 217, and 218 approach the right end portion of the respective cam gear portions 181, 182, and 183, respectively. Here, the side surface 175b of the cam barrel gear portion 175 formed at a lower portion of the outer circumferential surface of the cam barrel 161 contacts the Tele limit protruding portion 126, so that the cam barrel 161 is prevented from rotating further.

Actually, when the side surface 175a or 175b of the cam barrel gear portion 175 contacts the Wide limit protruding portion 125 or the Tele limit protruding portion 126,

that is, in the full Wide or Tele zoom state, an allowance "W" exists between each of the respective cam pins 216, 217, and 218 and the most left end of each of the slots 181, 182, and 183. By forming the cam slots 181, 182, and 183 to have such an allowance, the cam pins 216, 217, and 218 are prevented from escaping from the insertion holes.

FIGS. 25 through 27 show the relative positions of first through third lenses in a zoom state and the optical paths according to the lens positions.

Referring to FIG. 25, the first, second, and third lenses 21, 22, and 23 are linearly arranged and light passing through the lenses are incident on the image sensor 32 through the infrared ray shielding filter 31.

FIG. 25 shows a Wide zoom state in which the first lens 21 is disposed farthest from the image sensor 32 within a linear movement limit of the first lens 21 while the second and third lenses 22 and 23 are disposed closest to the image sensor 32 with linear movement limits of the second and third lenses 22 and 23.

FIG. 27 shows a Tele zoom state in which the first lens 21 is disposed closest to the image sensor 32 within the linear movement limit of the first lens 21 while the second lens 22 is separated farthest from the image sensor 32 with the linear movement limit of the second lens 22. The third lens 23 is separated farther from the image sensor 32 than the position shown in FIG. 15.

FIG. 26 shows a medium state between the Wide zoom state and the Tele zoom state, in which the first lens 21 and the second lens 22 are disposed at a position in the middle of the linear movement limit. On the contrary, the third lens 23 is disposed farthest from the image sensor 32 within the linear movement limit thereof.

FIG. 28 is a flow chart for explaining a method of controlling rotation of the driving motor. A DC motor is preferably used as the driving motor so that a portion to control the rotation of the DC motor is needed. In the present preferred embodiment, even when the user unnecessarily presses the Tele button 9 of FIG. 1 and the Wide button 10 of FIG. 1 for a long time, an overload applied to the DC motor can be prevented by limiting the rotation time of the DC motor within a predetermined limit. The limit in the rotation time can be set by a time during which the zoom is moved in the whole section from the Tele state to the Wide state.

Referring to the flow chart of FIG. 28, when a zoom operation starts by pressing the Tele button or Wide button (Step 281), it is determined whether an input signal is generated from the Tele button or the Wide button (Step 282 and 283). When the

input signal is generated from the Wide button, the driving motor rotates clockwise (Step 284). Next, it is determined whether the rotation time of the driving motor exceeds a time limit (Step 285). When the rotation time of the driving motor exceeds the time limit, the algorithm is terminated (Step 288). Otherwise, the driving motor continues to rotate by feedback. When the input signal is generated from the Tele button (Step 283), the driving motor rotates counterclockwise (Step 286). Next, it is determined whether the rotation time of the driving motor exceeds the time limit (Step 287). When the rotation time of the driving motor exceeds the time limit, the driving motor stops rotation (Step 288). Otherwise, the driving motor continues to rotate by feedback.

FIG. 29 shows a waveform of a voltage signal of a power applied to the DC driving motor provided in the present invention. The power is applied in form of a pulse waveform so that a portion 291 for applying the power and a portion 292 for not applying the power repeatedly alternate. By applying the power having the above pulse waveform to the DC driving motor, the driving motor can be prevented from being accelerated and a response speed is fast when it is required to be stopped.

FIG. 30 shows a state in which the compact digital zoom camera according to the present invention is installed in a cellular phone.

Referring to FIG. 30, a cellular phone includes a communication module 306 and a compact zoom camera module 350. A digital signal received through an antenna 309 is transmitted to a speaker 308 through the communication module 306 and a CPU 304. A voice signal received by a microphone 320 is transmitted to the antenna 309 through the CPU 304 and the communication module 306. The CPU 304 performs a predetermined operation by using data stored in a memory 205. An LCD (display portion) 307 displays a predetermined data according to the commands from the CPU 304.

A zoom camera operation signal input through the Tele button 301 and the Wide button 303 is transmitted to the driving IC 310 through the CPU 304. As the driving motor 311 is rotated by the driving IC 310, the zoom state of a lens assembly 312 can be changed. Light input through the lens assembly 312 is focused on an image sensor 313 and transmitted to the CPU 304. When a user presses a release button 304, an image formed on the image sensor 313 can be stored in a memory 305 as a digital image.

[Effect of the Invention]

As described above, the compact zoom camera according to the present invention has a simplified structure so that a possibility of being out of order and malfunctioning is reduced. Also, when where is an external impact, a possibility of being damaged is very low, in particular, the problem that the lens slips out of a portable device or a cam pin is broken can be presented. In addition, by embodying a compact zoom lens in a compact portable device, a camera performance and a photographing effect can be greatly improved.

While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A compact digital zoom camera comprising:

a module base having an image sensor therein;

a gear train installed at a side of an upper surface of the module base;

a lens guide base installed on the module base and having a guide cylinder portion integrally formed thereon in which at least two groups of linear guides are formed in a lengthwise direction thereof;

a driving motor installed at a motor installation portion on the lens guide base to rotate the gear train;

a cam barrel rotatably installed at an outer side of the lens guide base and having a cam barrel gear portion engaged with any gear of the gear train and at least two groups of cam slots formed there in;

at least two lens frames having at least two groups of linear guide portions respectively inserted in the two groups of linear guides of the lens guide base and guided thereby and at least two groups of cam pins respectively inserted in insertion holes formed in the linear guide portions and fixed therein such that end portions of the two groups of cam pins are respectively inserted in at least two groups of cam slots formed in the cam barrel and restricted thereby; and

at least two groups of lenses respectively fixed on the two groups of lens frames.

2. The compact digital zoom camera as claimed in claim 1, wherein the driving motor is a DC driving motor.

3. The compact digital zoom camera as claimed in either claim 1 or claim 2, wherein a waveform of a voltage signal of a power applied to the driving motor is pulse waveform having a portion for applying the power and a portion for not applying the power, and the power is applied for a time limit from a Tele zoom state to a Wide zoom state.

4. The compact digital zoom camera as claimed in claim 1, wherein the two groups of linear guides formed on the guide cylinder portion of the lens guide base are formed at an interval of 120° on the guide cylinder portion.

5. The compact digital zoom camera as claimed in claim 1, wherein the two groups of cam slots formed in the cam barrel includes first through third cam slots, the first cam slot and the second cam slot are inclined in the opposite direction to each other, and the third cam slot has a reversed V shape.

6. The compact digital zoom camera as claimed in either claim 1 or claim 5, wherein an allowance is formed between an end portion of each of the two groups of cam slots and each of the two groups of cam pins when the cam barrel is in the Tele or Wide zoom state.

7. The compact digital zoom camera as claimed in claim 1, wherein the two groups of lenses are respectively installed inside lens holders and at least one lens holder is fixed to at least one lens frame.

8. The compact digital zoom camera as claimed in either claim 1 or claim 7, wherein at least two groups of lens shields to limit an optical axis and protect the lenses are respectively arranged on surfaces of the two groups of lenses.

9. The compact digital zoom camera as claimed in claim 1, wherein the gear train comprises:

a motor gear connected to a rotation shaft of the driving motor;
first through fifth reduction gears to reduce the rotation of the motor gear; and
a transmission gear engaged with the cam barrel gear portion.

10. The compact digital zoom camera as claimed in claim 1, wherein the gear train is inserted in a concave formed in an upper surface of the module base.

11. The compact digital zoom camera as claimed in claim 1, wherein an infrared ray shielding filter is arranged in front of the image sensor in the module base.

12. A cellular phone having a compact digital zoom camera comprising:

a module base having an image sensor therein;
a gear train installed at a side of an upper surface of the module base;

a lens guide base installed on the module base and having a guide cylinder portion integrally formed thereon in which at least two groups of linear guides are formed in a lengthwise direction thereof;

a driving motor installed at a motor installation portion on the lens guide base to rotate the gear train;

a cam barrel rotatably installed at an outer side of the lens guide base and having a cam barrel gear portion engaged with any gear of the gear train and at least two groups of cam slots formed there in;

at least two lens frames having at least two groups of linear guide portions respectively inserted in the two groups of linear guides of the lens guide base and guided thereby and at least two groups of cam pins respectively inserted in insertion holes formed in the linear guide portions and fixed therein such that end portions of the two groups of cam pins are respectively inserted in at least two groups of cam slots formed in the cam barrel and restricted thereby; and

at least two groups of lenses respectively fixed on the two groups of lens frames.

13. A portable digital device having a compact digital zoom camera comprising:

a module base having an image sensor therein;

a gear train installed at a side of an upper surface of the module base;

a lens guide base installed on the module base and having a guide cylinder portion integrally formed thereon in which at least two groups of linear guides are formed in a lengthwise direction thereof;

a driving motor installed at a motor installation portion on the lens guide base to rotate the gear train;

a cam barrel rotatably installed at an outer side of the lens guide base and having a cam barrel gear portion engaged with any gear of the gear train and at least two groups of cam slots formed there in;

at least two lens frames having at least two groups of linear guide portions respectively inserted in the two groups of linear guides of the lens guide base and guided thereby and at least two groups of cam pins respectively inserted in insertion holes formed in the linear guide portions and fixed therein such that end portions of the

two groups of cam pins are respectively inserted in at least two groups of cam slots formed in the cam barrel and restricted thereby; and

at least two groups of lenses respectively fixed on the two groups of lens frames.

14. A compact digital zoom camera comprising:

a module base having an image sensor therein;

an infrared ray shielding filter arranged in front of the image sensor in the module base;

a gear train inserted in a concave formed in an upper surface of the module base;

a lens guide base installed on the module base and having a guide cylinder portion integrally formed thereon in which at least two groups of linear guides are formed in a lengthwise direction thereof;

a driving motor installed at a motor installation portion on the lens guide base to rotate the gear train;

a cam barrel rotatably installed at an outer side of the lens guide base and having a cam barrel gear portion engaged with any gear of the gear train and at least two groups of cam slots formed there in;

at least two lens frames having at least two groups of linear guide portions respectively inserted in the two groups of linear guides of the lens guide base and guided thereby and at least two groups of cam pins respectively inserted in insertion holes formed in the linear guide portions and fixed therein such that end portions of the two groups of cam pins are respectively inserted in at least two groups of cam slots formed in the cam barrel and restricted thereby; and

at least two groups of lenses respectively fixed on the two groups of lens frames.

15. A compact digital zoom camera comprising:

a module base having an image sensor therein;

a gear train installed at a side of an upper surface of the module base;

a driving IC mounted on a PCB installed at a side of the driving motor to control the driving motor;

a lens guide base installed on the module base and having a guide cylinder portion integrally formed thereon in which at least two groups of linear guides are formed in a lengthwise direction thereof;

a driving motor installed at a motor installation portion on the lens guide base to rotate the gear train;

a cam barrel rotatably installed at an outer side of the lens guide base and having a cam barrel gear portion engaged with any gear of the gear train and at least two groups of cam slots formed there in;

at least two lens frames having at least two groups of linear guide portions respectively inserted in the two groups of linear guides of the lens guide base and guided thereby and at least two groups of cam pins respectively inserted in insertion holes formed in the linear guide portions and fixed therein such that end portions of the two groups of cam pins are respectively inserted in at least two groups of cam slots formed in the cam barrel and restricted thereby; and

at least two groups of lenses respectively fixed on the two groups of lens frames.

FIG. 1

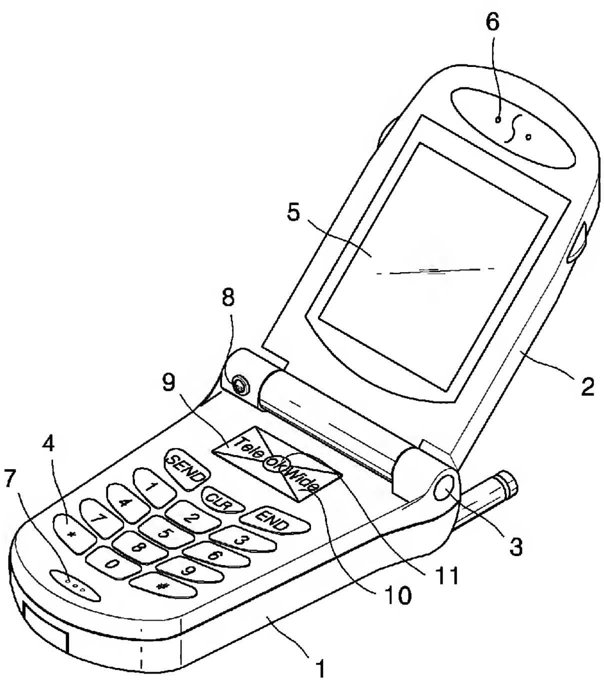


FIG. 2

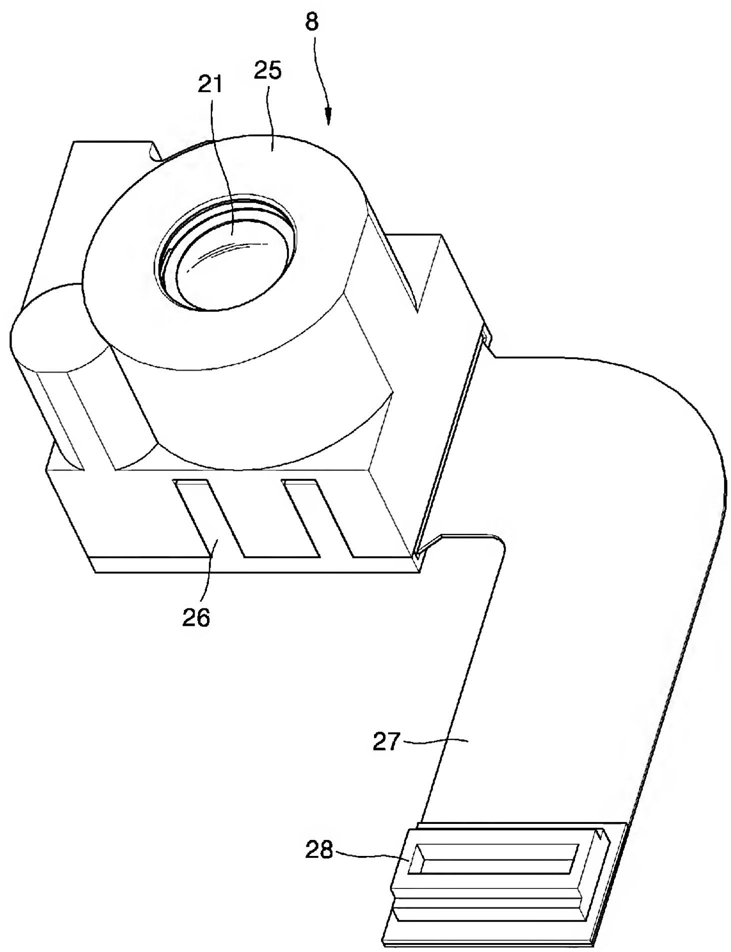


FIG. 3

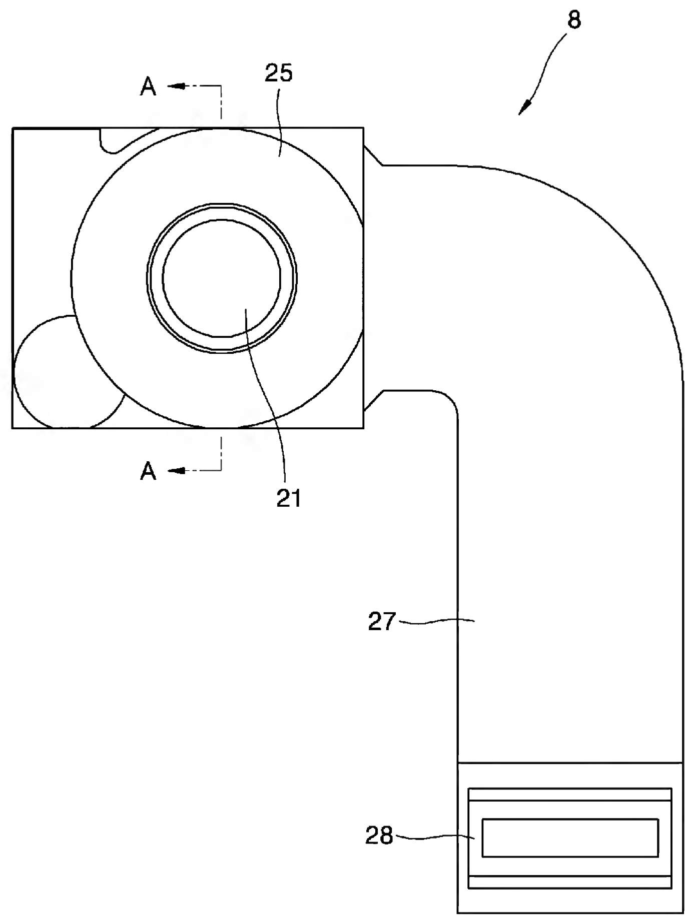


FIG. 4

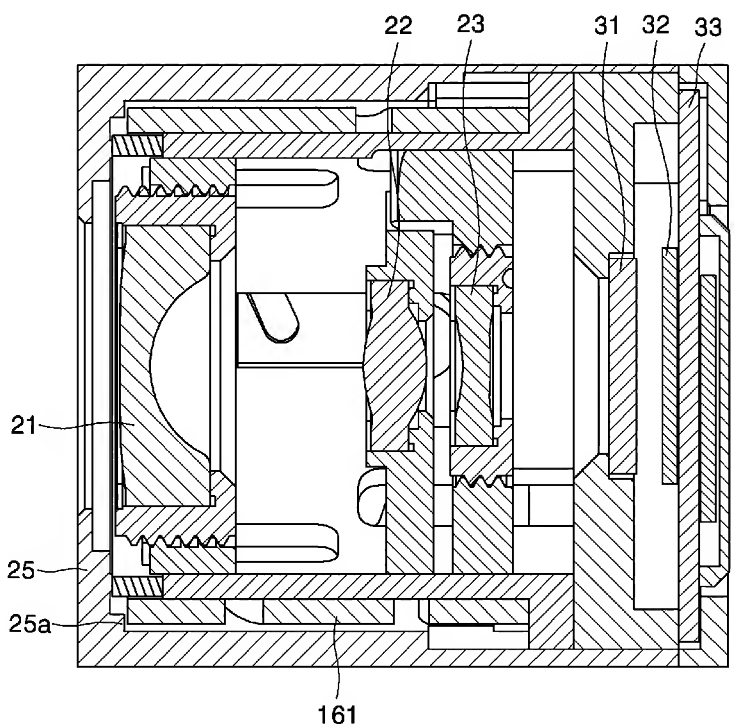


FIG. 5

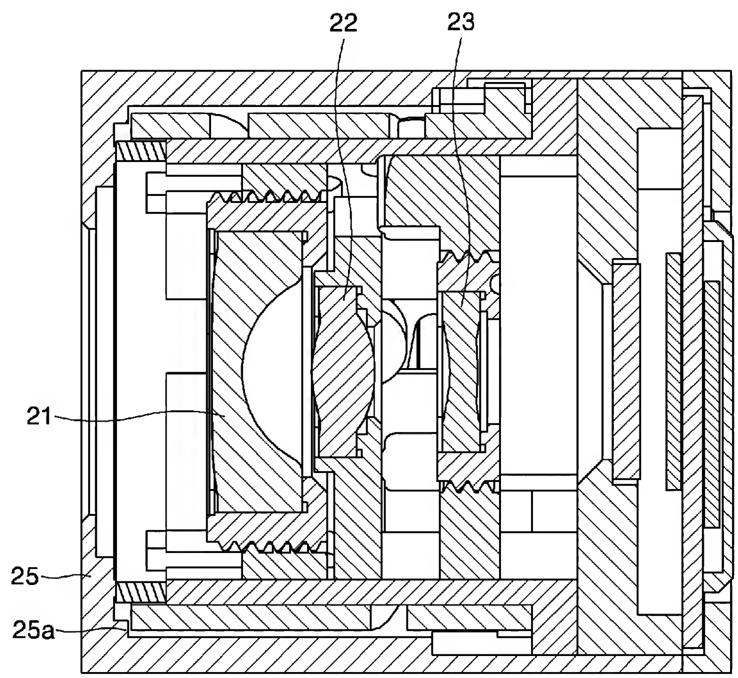


FIG. 6

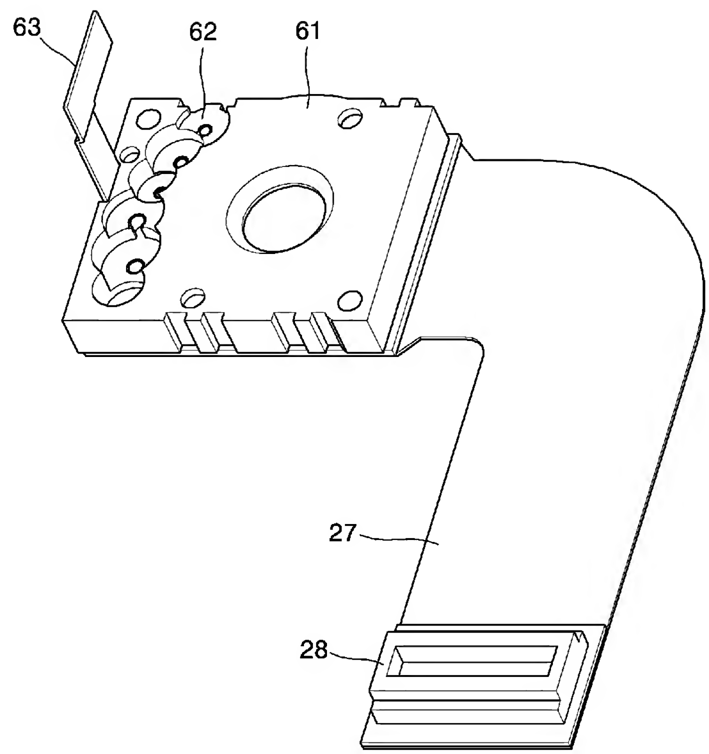


FIG. 7

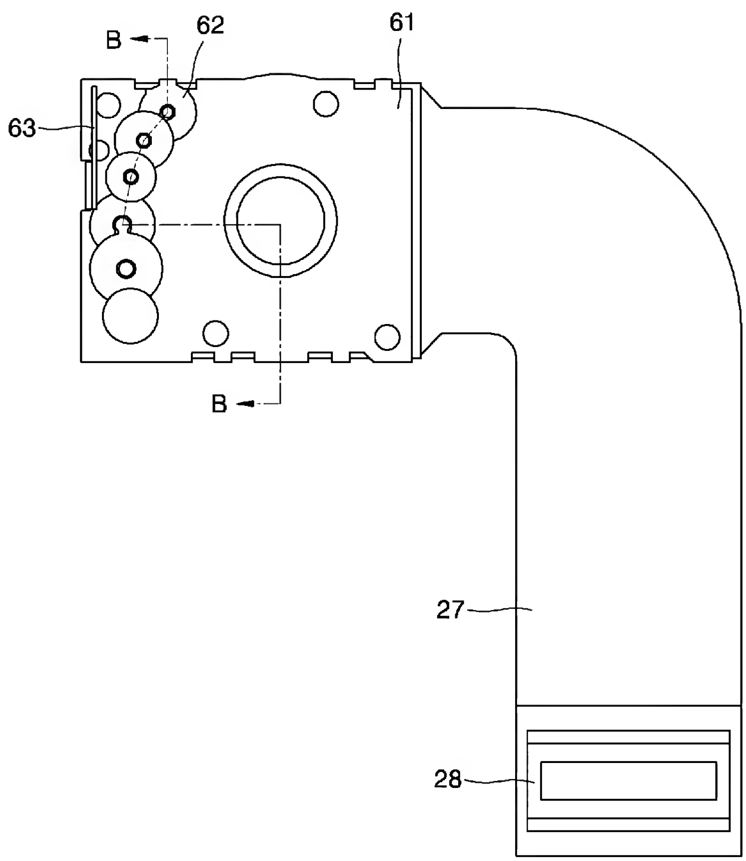


FIG. 8

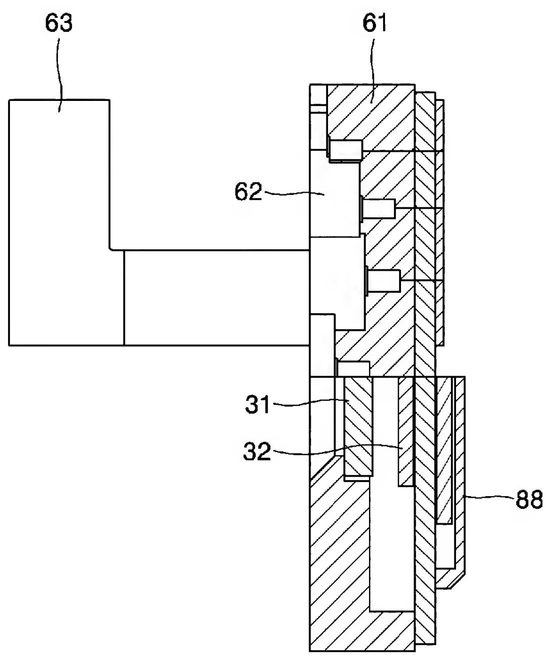


FIG. 9

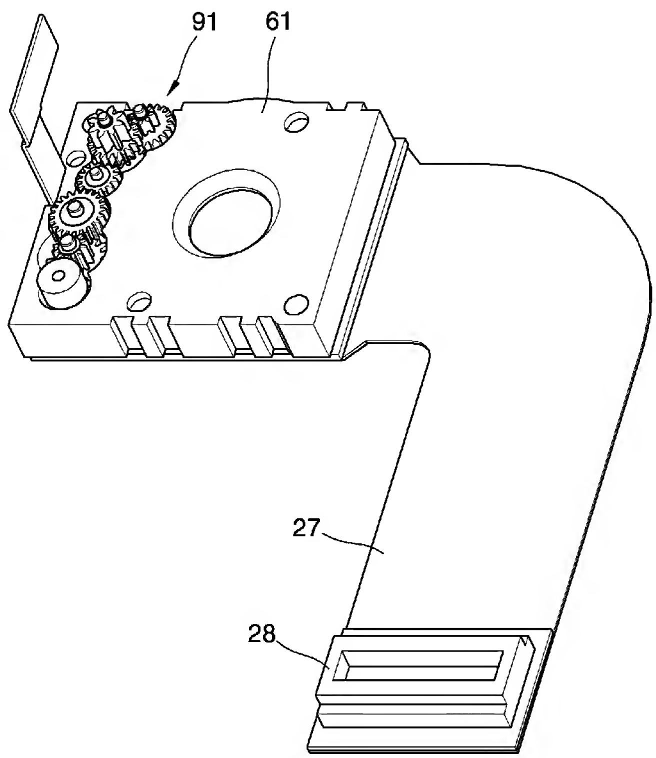


FIG. 10

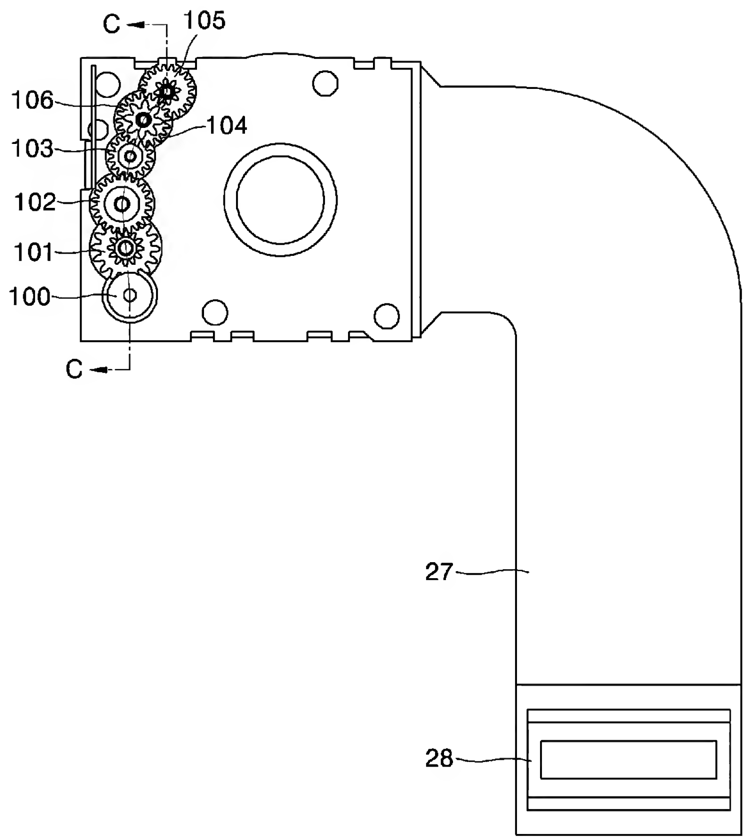


FIG. 11

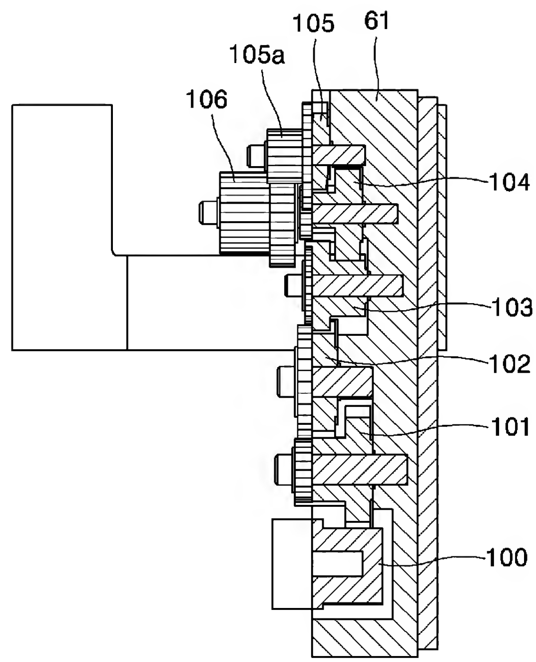


FIG. 12

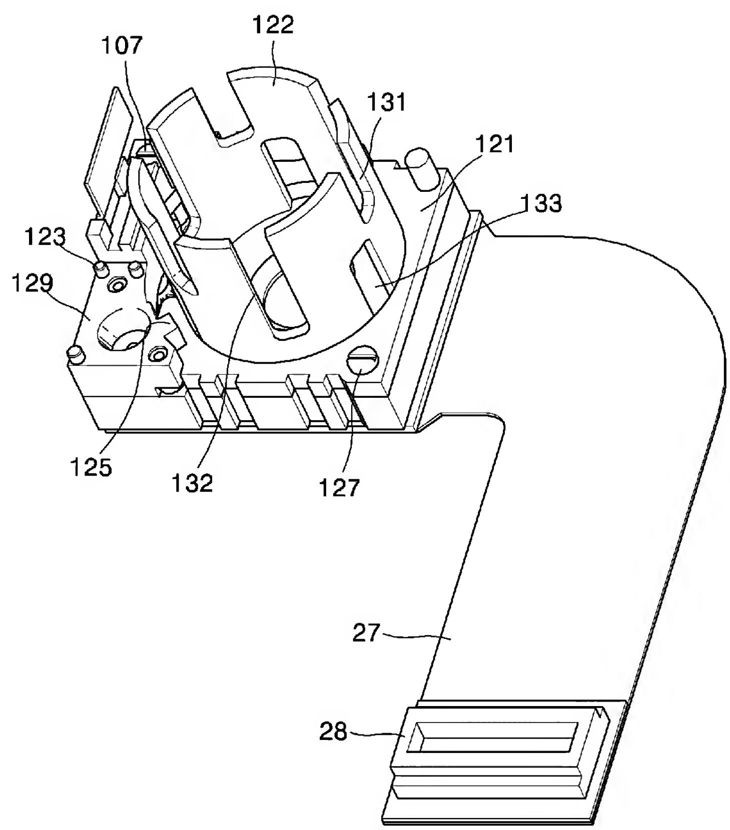


FIG. 13

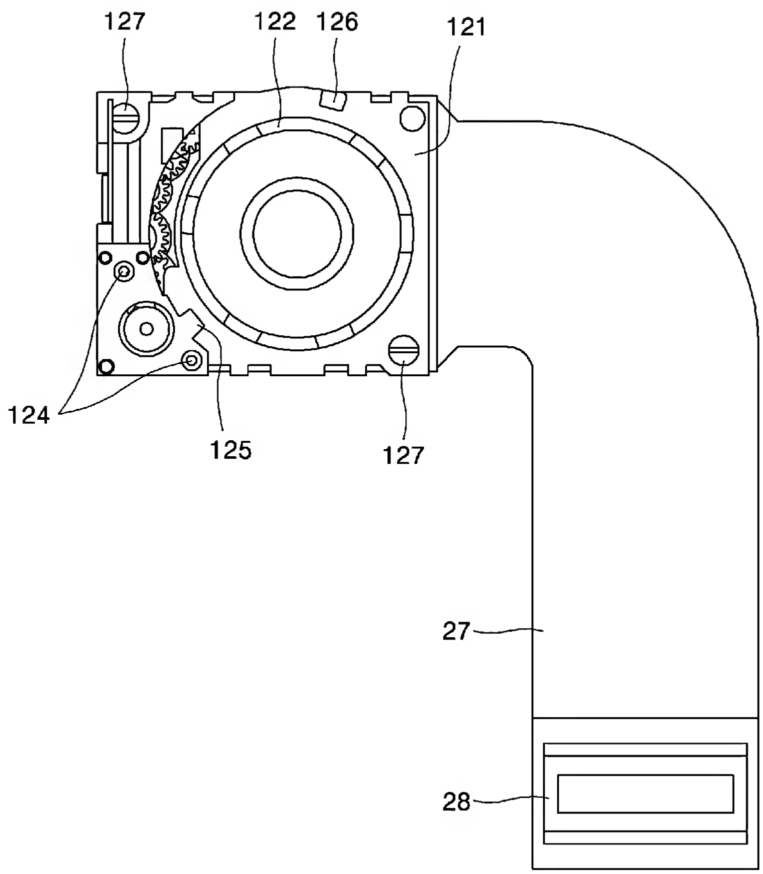


FIG. 14

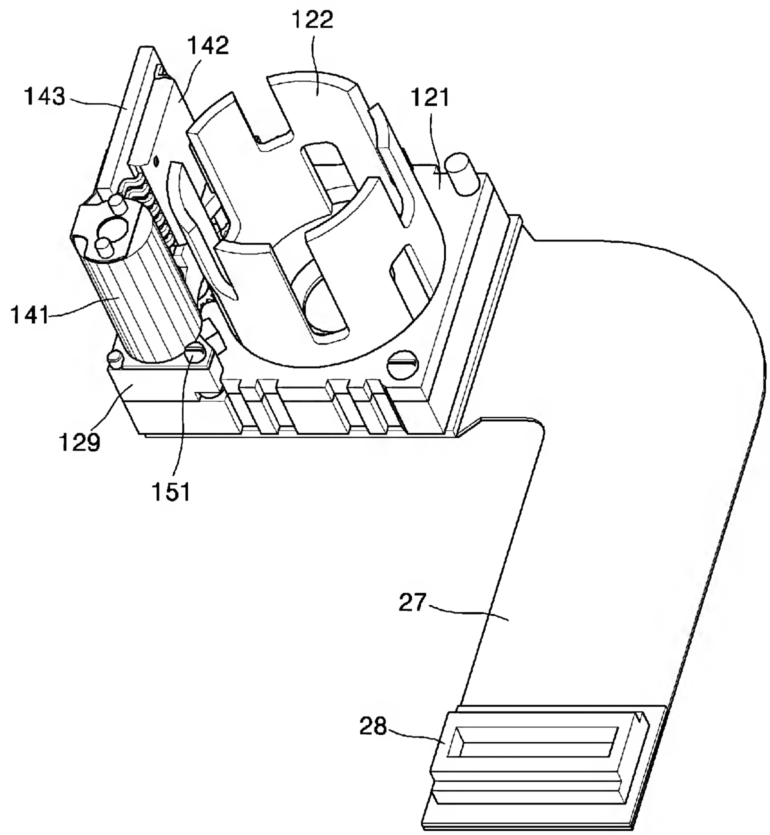


FIG. 15

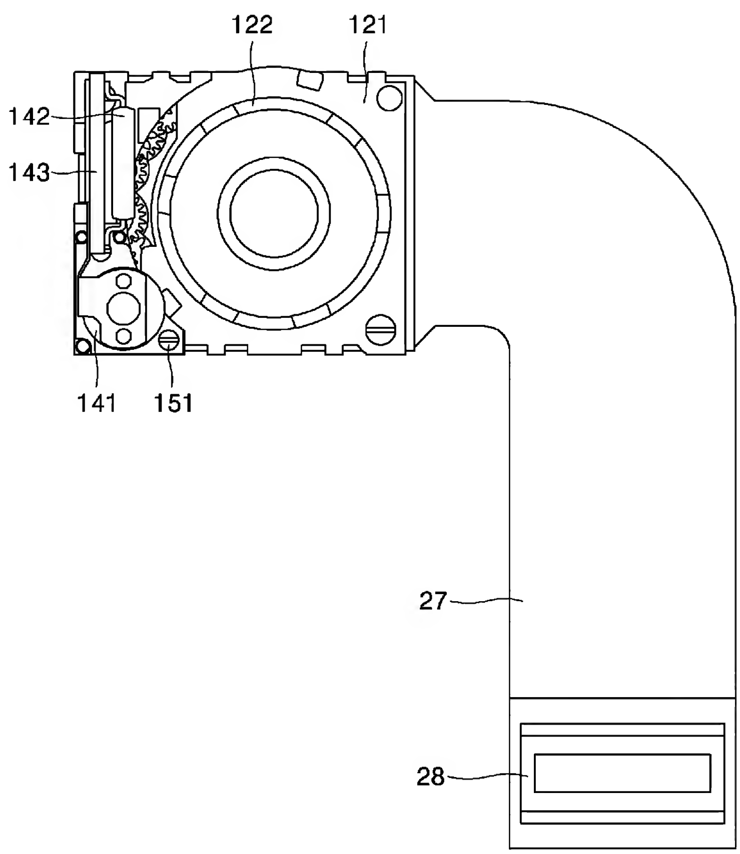


FIG. 16

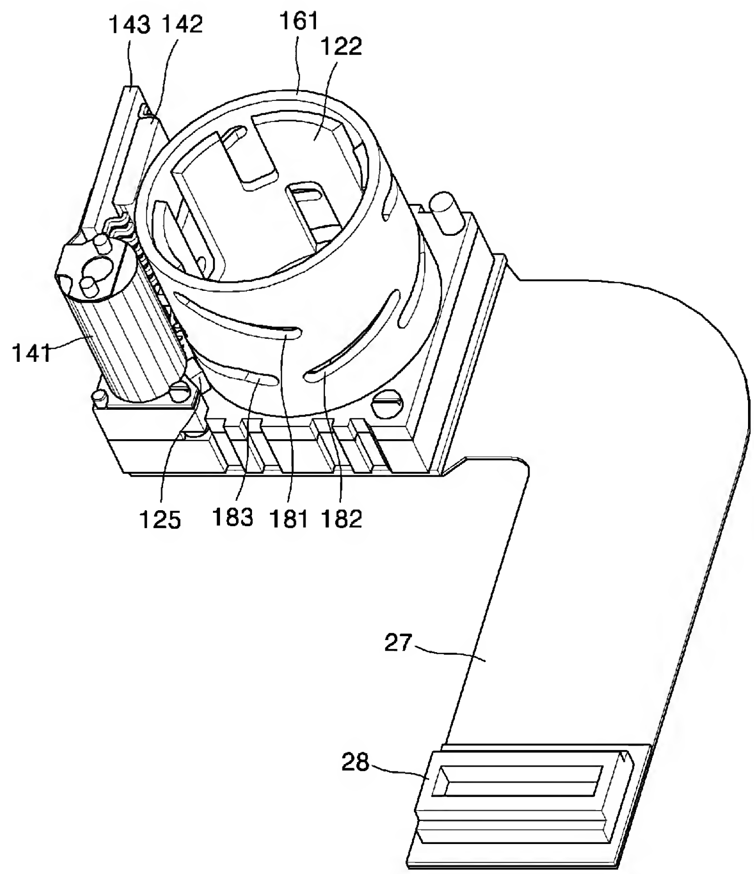


FIG. 17

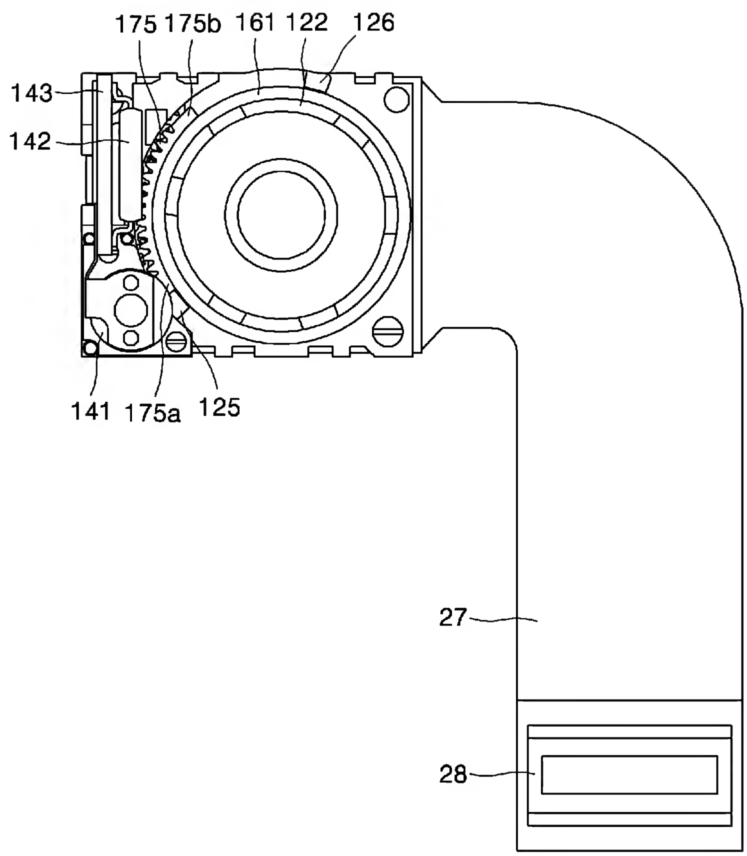


FIG. 18

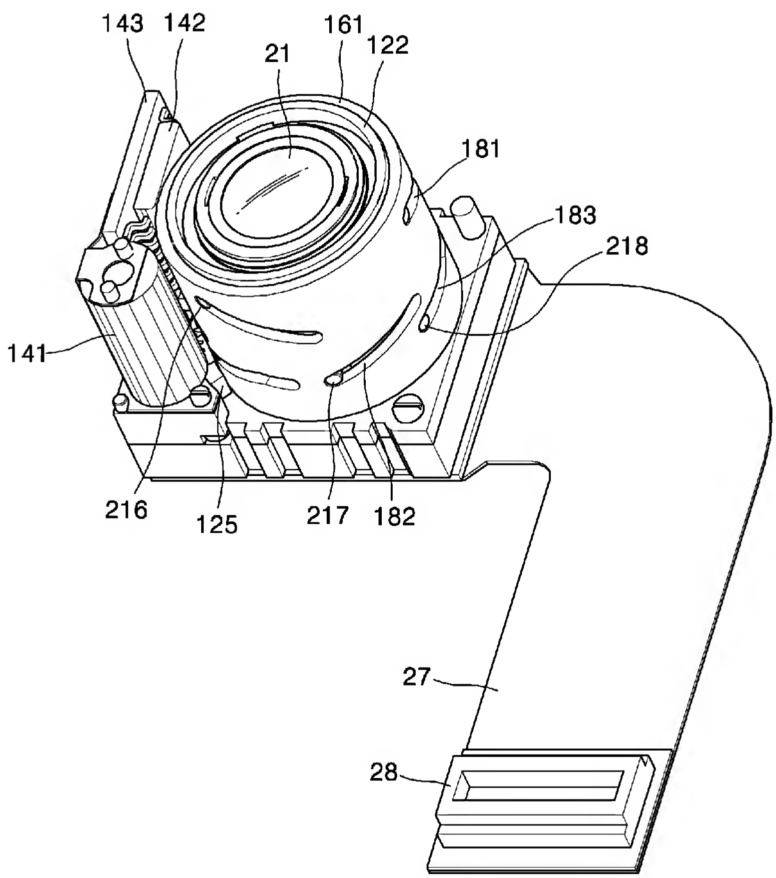


FIG. 19

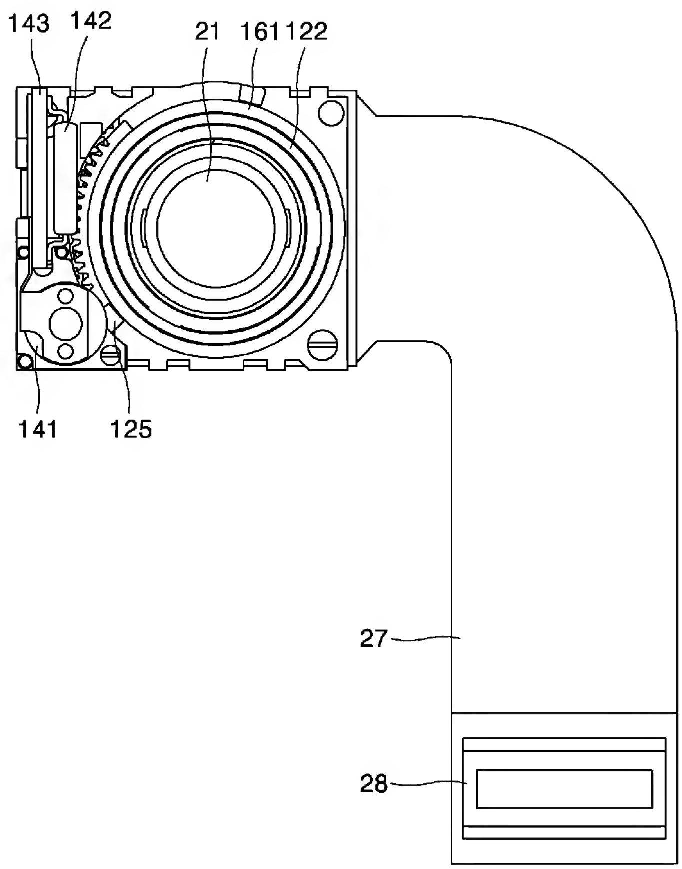


FIG. 20

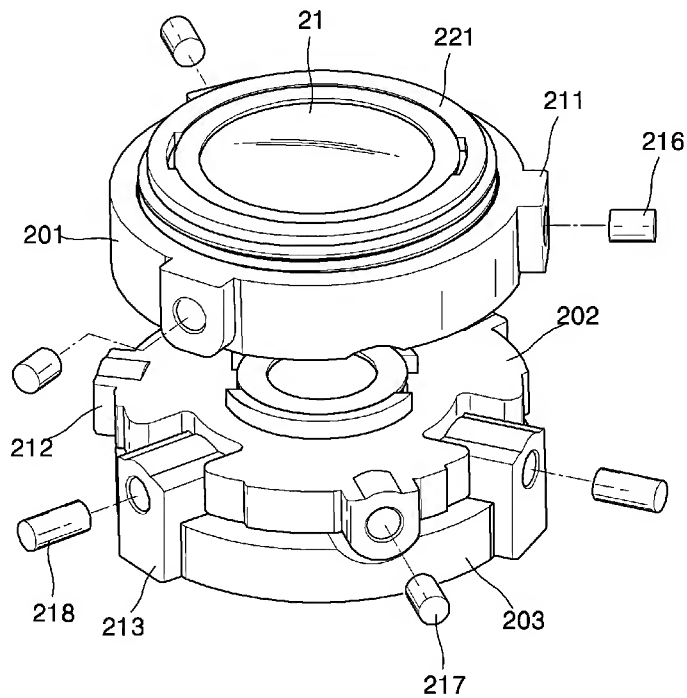


FIG. 21

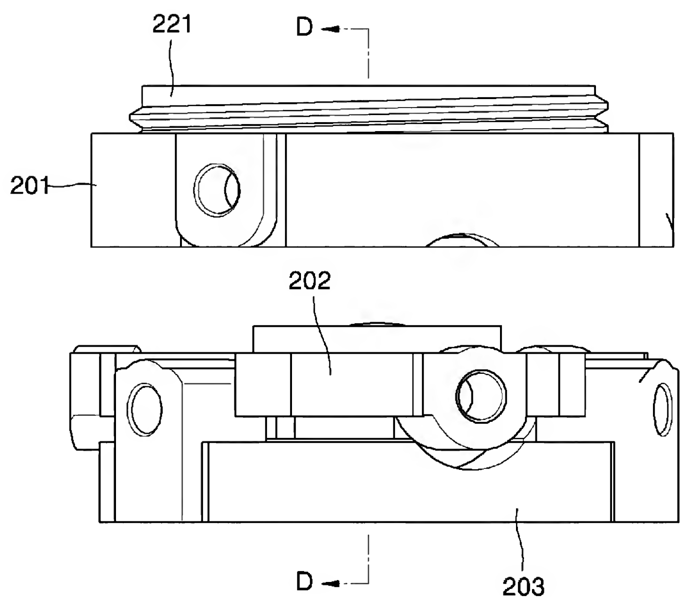


FIG. 22

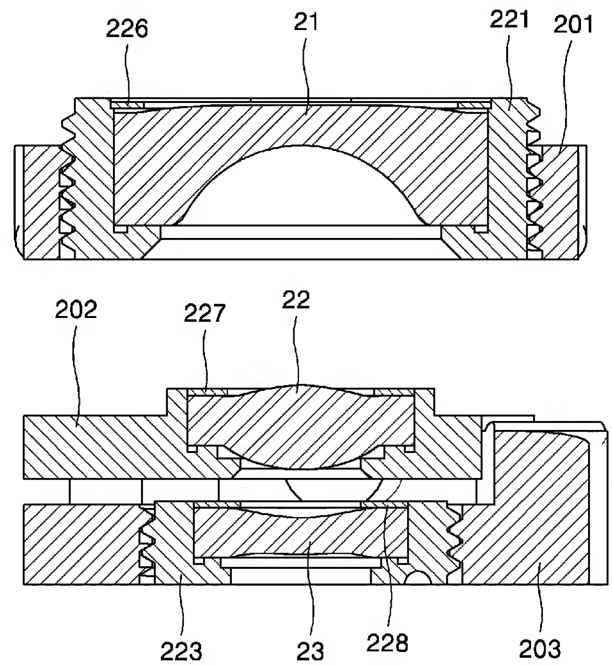


FIG. 23

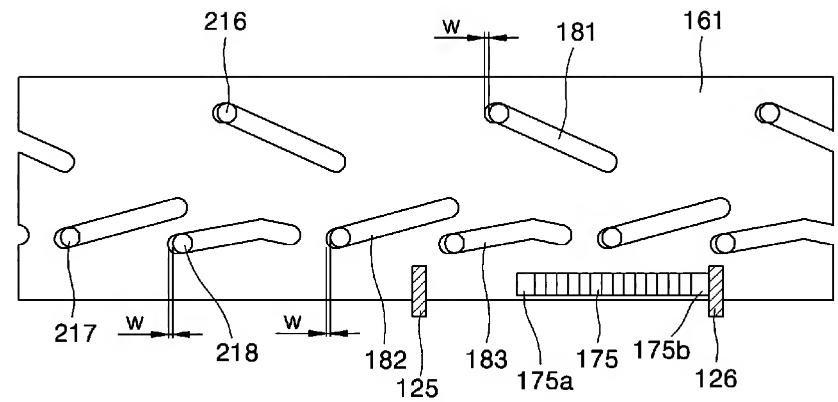

216
w
181
161
217
w
218
w
182
125
183
175a
175
175b
126

FIG. 24

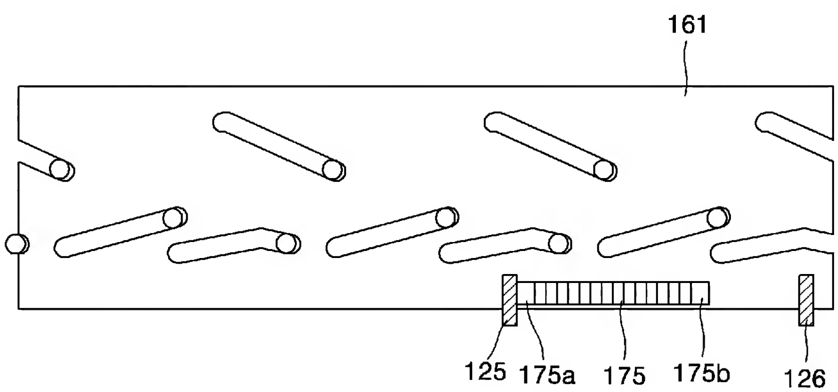

161
125
175a
175
175b
126

FIG. 25

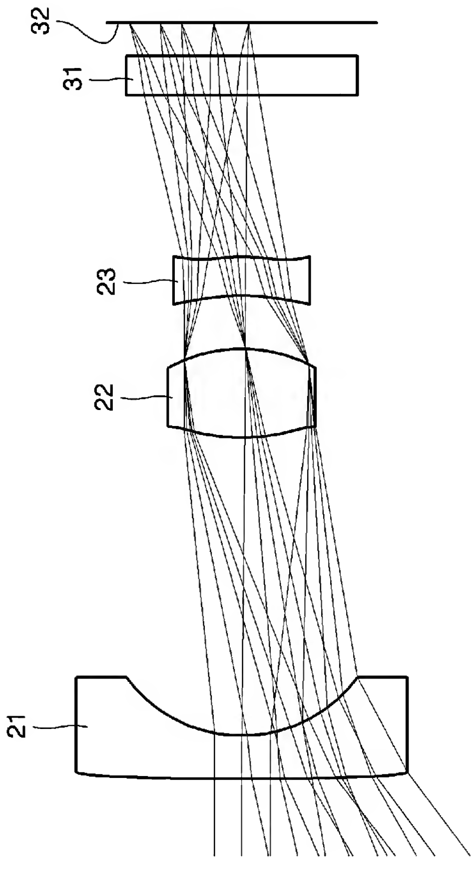


FIG. 26

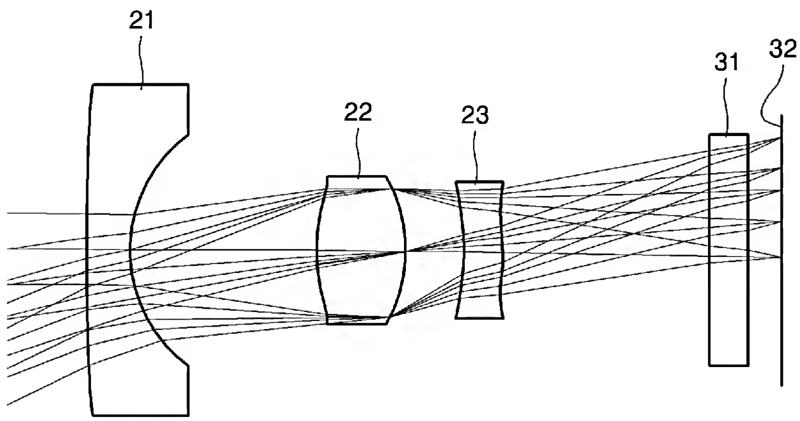


FIG. 27

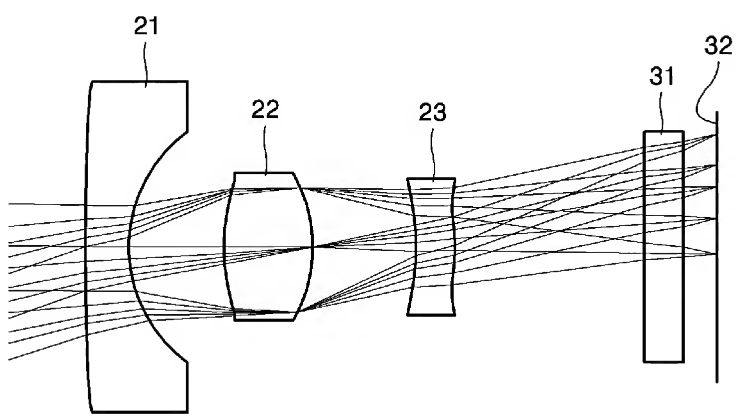


FIG. 28

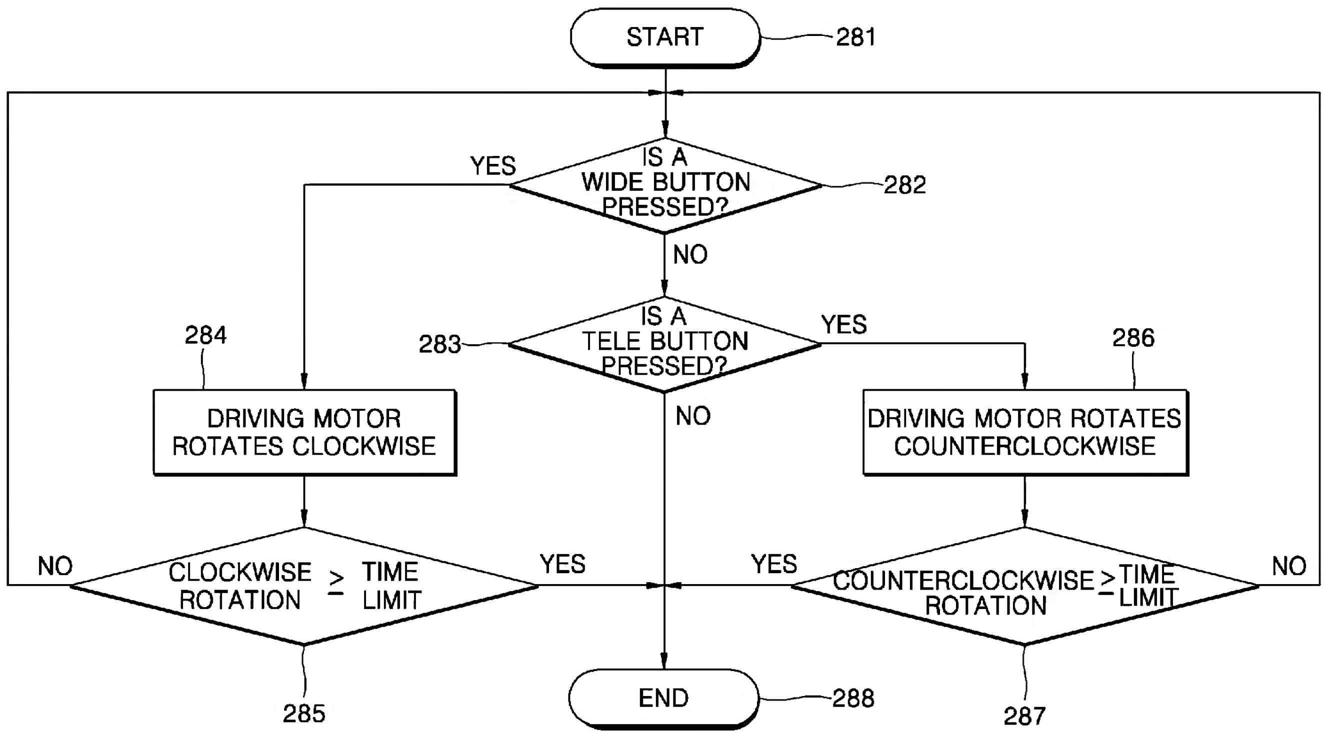

START
281
IS A WIDE BUTTON PRESSED?
282
YES
NO
IS A TELE BUTTON PRESSED?
283
YES
NO
DRIVING MOTOR ROTATES CLOCKWISE
284
DRIVING MOTOR ROTATES COUNTERCLOCKWISE
286
CLOCKWISE ROTATION ≥ TIME LIMIT
285
NO
YES
COUNTERCLOCKWISE ROTATION ≥ TIME LIMIT
287
YES
NO
END
288

FIG. 29

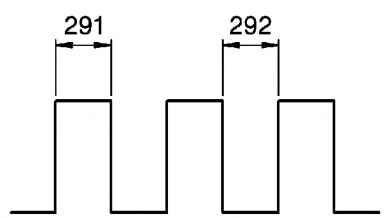
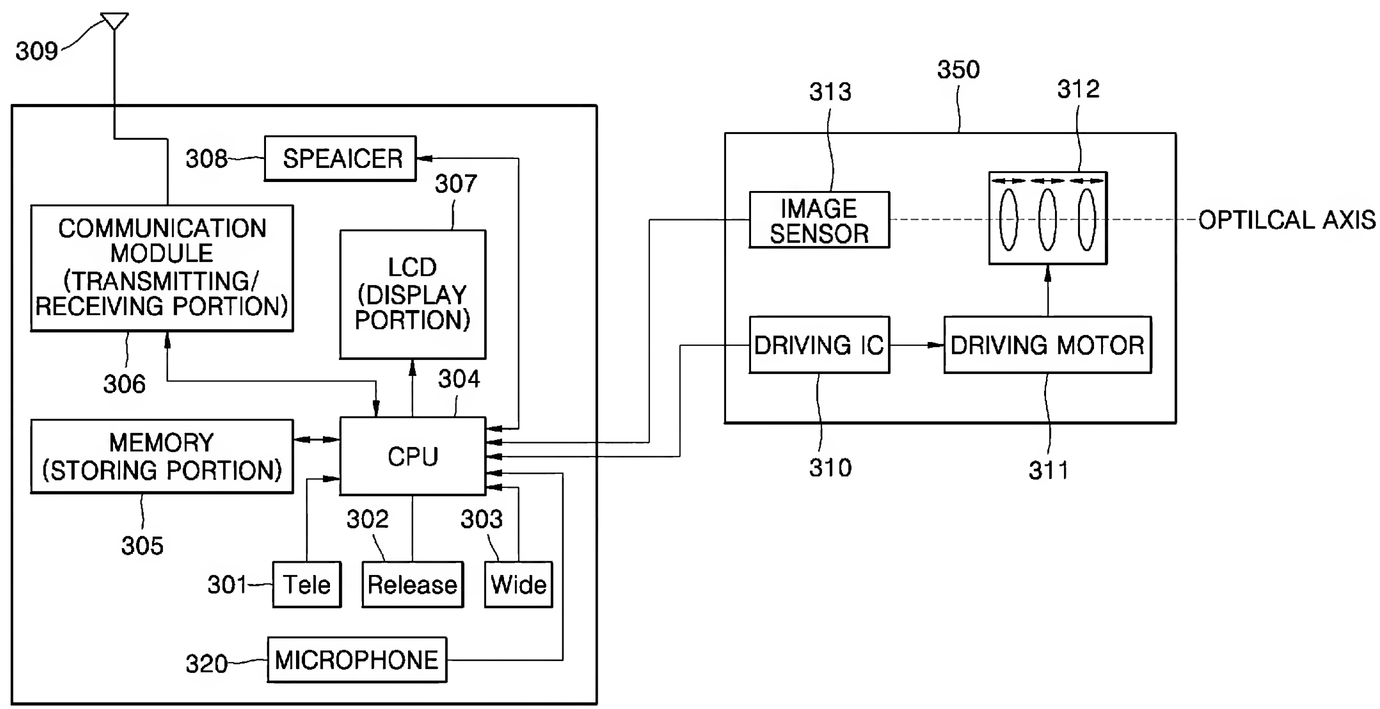


FIG. 30


309
308
SPEAICER
307
COMMUNICATION MODULE (TRANSMITTING/ RECEIVING PORTION)
LCD (DISPLAY PORTION)
306
304
MEMORY (STORING PORTION)
CPU
302
303
305
301
Tele
Release
Wide
320
MICROPHONE
350
313
312
IMAGE SENSOR
OPTILCAL AXIS
DRIVING IC
DRIVING MOTOR
310
311